Proc. Indian natn. Sci. Acad. **B48** No. 4 pp. 513–517 (1982)

Hyperphagia, Fattening and Testicular Responses to Exogenous Testosterone Propionate in Migratory Red-Headed Bunting, *Emberiza bruniceps*

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(Received 27 February 1982; after revision 25 June 1982)

Male migratory red-headed buntings (*Emberiza bruniceps*) collected in early preparatory phase when administered with testosterone propionate (0.25 mg/bird/day) in peanut oil intramuscularly showed spermatokinetic effects with concurrent increase in hyperphagia and body weight, the latter presumably accounts for the enormous sub-cutaneous fat deposition caused by testosterone. Testicular steroid seems to play an important role in vernal pre-migratory fattening with hyperphagia and a spectacular testicular development.

Key Words: Testosterone, Hyperphagia, Testis, Avian migration

Introduction

Although role of gonadal hormone in migratory birds, is still disputed, there are considerable reports available to the effect that exogenous testosterone propionate (TP) induces hyperphagia and fattening as in male migratory sparrows (Stetson & Erickson 1972, Yokoyama 1976) and in red-winged blackbirds (Robinzon & Rogers 1979). Further, castration of male migratory sparrow, *Zonotrichia leucophrys gambelii* alleviated the pre-migratory fat deposition (Weise 1967). Unfortunately, the investigation concerning gonadal responses to this exogenous TP-induced hyperphagia and fattening did not receive much attention. Recently, Robinzon and Rogers (1979) showed that exogenous TP. causes atrophy to testis and reduction in seminiferous tubules, but concurrently induced hyperphagia and obesity in the red-winged blackbirds. As a contrast, in nature, the vernal pre-migratory fattening and hyperphagia is concomitant with testicular development (Berthold 1975). This relationship also holds good in migratory red-headed buntings (our unpublished data). In view of this we designed the present experiment to administer testosterone exogenously to male migratory red-headed buntings, *Emberiza bruniceps*, in early preparatory phase to observe its effect on hyperphagia and fattening in relation to the testicular condition.

Material and Methods

Red-headed buntings (*Emberiza bruniceps*) are 'moderate distance' migratory passarines

wintering in India from August/September to mid/late April. In nature these birds show heavy subcutaneous fat deposition with mature gonads at mid- to late April (their vernal pre-migratory period).

Adult male birds were collected in early March. After a 5-day acclimatization in laboratory conditions (in natural photo-period) only a few birds were killed to observe their testicular condition. Average body weight of the birds was between 23 and 24.5g. Testosterone propionate, dissolved in peanut oil, was administered intramuscularly at a dosage of 0·25 mg/bird daily at 14.00 hr. Controls received the vehicle (oil) only.

Hyperphagia Experiment

Five birds each from the treated ones and controls were kept individually in cages. Food grains weighed in a small plastic cup and placing it in a larger one to avoid the loss of spillage, were given to each cage. Water was given *ad libitum*. After 24 hours unconsumed food grain and spillage was weighed. By substracting this weight from the initial one, daily consumption for each bird was calculated. Mean for five birds of each group was taken. The recording of food consumption was done on every 5th day from the beginning of the experiment.

A few birds from each group were autopsied (at 14.00 hr) on the 11th day and the rest on the 21st day. After killing, body weight was taken on a Pan-balance and subcutaneous fat deposition was noted. Left testes were weighed and discarded, the right ones were fixed in Bouin's fluid. 5μm paraffin sections of testes were cut, stained with Masson's trichrome and PA-Schiff haematoxylin to reveal spermatogenetic condition. Tubular diameter was measured by estimating the mean of 50 round tubules for 5 sections of each specimen. Interstitial Leydig's cell nuclei diameter was measured by estimating the mean of 100 nuclei for 10 different sections of each specimen. The statistical analysis was done by the Student's 't' test.

Results

The same experiment was done on two consecutive years and the data are based on both year's findings. Gravimetric and karyometric data of control and treated groups are given in table 1. Hyperphagia of both groups

Table 1 *Body weight, testicular weight, seminiferous tubular and Leydig cell nuclear diameter in control and TP-treated buntings*

		Body weight (g)	Testis weight (mg)	Seminiferous tubular diameter (μm)	Leydig cell nuclear diameter (μm)
10 days	Control (n = 10)	24.5±0.28*	1.48±0.14	104.33±4.80	4.77±0.21
	Treated (n = 12)	28.75±0.47 ($p < 0.001$)	12.68±5.33 ($p < 0.05$)	245.00±32.79 ($p < 0.001$)	4.90±0.17 (N.S.)**
20 days	Control (n = 10)	24.51±1.06	2.80±0.91	158.05±29.34	4.65±0.16
	Treated (n = 12)	29.61±1.80 ($p < 0.025$)	55.65±13.24 ($p < 0.001$)	404.62±17.00 ($p < 0.001$)	4.91±0.06 (N.S.)

* Mean±S.E.; ** Not significant

Figure 1 : Marked deposition of subcutaneous fat in 20-days TP-treated birds (left). Note the control (right) is perceptibly devoid of fat

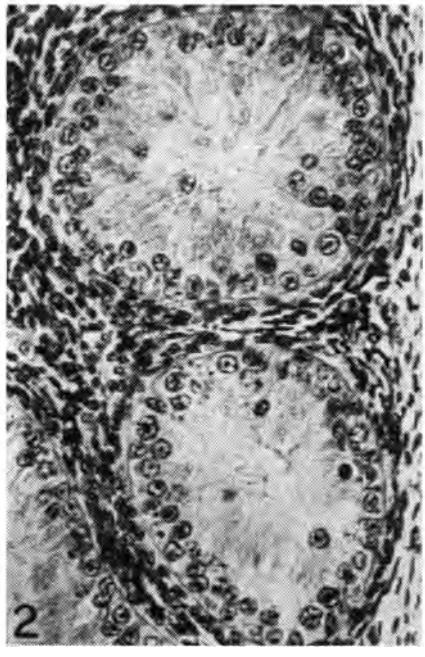

Figure 2 Histological section of testis of bunting in early preparatory phase. Note preponderance of spermatogonia (×350)

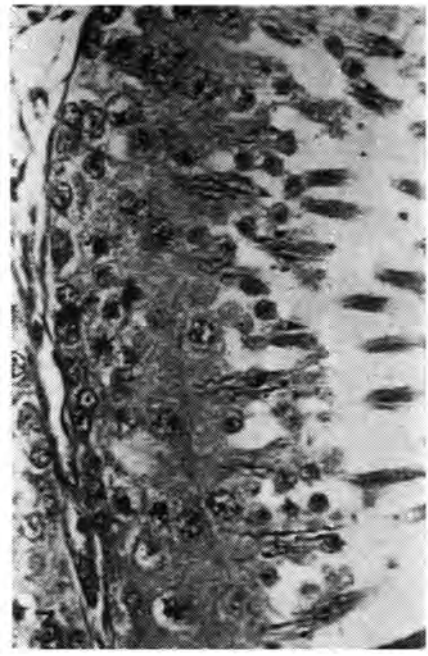

Figure 3 Testis of TP-injected bird (having same phase of migration) for 20-days. Observe the appearance of all types of germinal elements including spermatozoa (× 350)

Table 2 *Daily food-intake (in g) of control and TP-treated birds*

	6th day	11th day	16th day	21st day
Control (n = 5)	4.70±0.25*	5.50±0.34	5.50±0.30	5.77±0.20
Treated (n = 5)	6·00±0.40 ($p < 0.025$)	6.00±0.10 (NS)	7.25±0.47 ($p < 0.01$)	8.75±0.25 ($p < 0.001$)

*Mean±S.E; *NS*, Not Significant

are shown in table 2. TP-treated birds showed deposition of subcutaneous fat, which was moderate in 10-days treatment and pretty high in 20-days treatment while the untreated birds had only negligible fat content (figure 1).

Histological Observations

Control: Large number of spermatogonial cells with scattered primary spermatocytes characterise the testes of oil-treated birds. Two birds only showed very few secondary spermatocytes. Aggregated Leydig cells presented round nuclei surrounded by a clear cytoplasm (figure 2).

10-days TP-treated: All buntings of this experimental group showed a uniform occurrence of secondary spermatocytes. Considerable tubular expansion caused a dispersion of the Leydig cells.

20-days TP-treated: All stages of spermatogenesis including PA-Schiff positive spermatozoa were revealed in the seminiferous tubules of the long term TP-treated birds (figure 3). Due to a still greater expansion of tubules totally dispersed Leydig cells were only seen scatteredly.

Discussion

The present experimental findings indicate that the testosterone plays a biphasic role in the migratory bunting, by inducing hyperphagia, consequently fattening in one hand and concurrent testicular development in another.

TP-induced hyperphagia and fattening resemble the existing observations on migratory sparrows (Stetson & Erickson 1972, Yokoyama 1975) and resident blackbirds (Robinzon & Rogers 1979). In migratory birds (also in resident birds) such action of TP is probably mediated through the release of pituitary prolactin, which in turn induces hyperphagia and fattening (Yokoyama 1976, Robinzon & Rogers 1979). It may be recalled here that exogenous prolactin can cause hyperphagia and fattening in bunting also (Chattopadhyay 1982).

Gonadal responses to exogenous androgen, that induces hyperphagia and fattening is very little explored so far in case of migratory birds. In the present experiment, testicular activities augmented in all hormone-treated groups, while interstitial Leydig cells remain unchanged in contrast to the control (table 1). This result is in variance with that of Robinzon and Rogers (1979) in blackbirds, where exogenous TP causes testicular atrophy. This variation can be attributed to a probable difference in the 'physiological make-up' between certain migratory and non-migratory birds. It is possible that TP-induced hyperphagia and fattening is through prolactin secretion in both cases, but gonadal response to this TP-triggered prolactin is different. In support of the latter the work of Meier et al. (1968) may be cited. We have shown that exogenous prolactin plays an antigonadal role in non-migrants, but fails to stop photostimulated gonadal growth in migrants.

In the present migratory species, testicular hormone played an integral role in the pre-migratory phase by inducing hyperphagia with fattening and testicular growth.

Acknowledgements

This work was supported by a grant from the Department of Science and Technology to Professor Asok Ghosh. The authors are grateful to Miss Sabita Pal and Mr S Chakraborty for their kind assistance.

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